

# Hydrological Summary

## for the United Kingdom

### General

August saw the end of the exceptional cyclonicity which produced outstanding late spring and early summer rainfall across much of southern Britain. August rainfall totals, though spatially very variable, were generally within the normal range. Nonetheless, the UK registered its wettest summer (June-August) in a series from 1914. Correspondingly, runoff totals for the summer were outstanding across much of the country with river flow patterns more typical of the winter. Importantly, appreciable soil moisture deficits have developed over the last six weeks, moderating the flood risk which, remarkably, was high over wide areas at the beginning of August. Entering the autumn, overall reservoir stocks for England & Wales were the 2<sup>nd</sup> highest in a 20-yr record; most reservoir levels being well above the monthly average. With exceptionally high August groundwater levels characterising many aquifer outcrop areas, the groundwater resources outlook is also very healthy. However, the normal (November-April) recharge season is very likely to begin with seasonally elevated groundwater levels in many areas. Correspondingly, an enhanced risk of groundwater flooding may be expected to persist through the late autumn and winter – much will depend on the spatial and temporal distribution of rainfall over the next six months.

### Rainfall

The relentless passage of low pressure systems, across southern Britain especially, eased in August although the mid-month period was unsettled and a preponderance of northerly airflows often gave the weather an autumnal complexion. Vigorous frontal systems produced notable storm totals in western Scotland (Kinlochewe recorded 69mm on the 7<sup>th</sup> and 56mm on the 13<sup>th</sup>) and a number of locally intense storms were reported (e.g. 40mm in 5hrs at Brixham on the 21<sup>st</sup>) but flash flooding incidents were much rarer than in June and July. A protracted dry spell developed in southern Britain as anticyclonic conditions became established. In parts of central southern England accumulated rainfall totals, from the 22<sup>nd</sup>, remained below 5mm for 20 or more days. This dry spell contributed to August rainfall totals well below average in a broad zone from the North East to the Bristol Channel. By contrast, parts of the Scottish Highlands approached twice the 1961-90 average; some catchments reporting their wettest August for 15 years. Notwithstanding the limited August rainfall in many central areas, the summer rainfall for England & Wales was the highest since 1912 (notably wet summers were rather more common in the 19<sup>th</sup> century). National and regional rainfall accumulations are exceptional across a range of durations. Remarkably, the September-August period is the wettest 12-month sequence (for any start month) on record for Scotland; in this timeframe very large positive anomalies characterise most regions of Great Britain.

### River flows

August began with many catchments exceptionally vulnerable to further significant rainfall; a very rare circumstance given the number of major basins involved. Some notable summer spates were reported (e.g. on the Ewe, Taw, and Dorset Stour) and isolated intense storms overwhelmed local drainage capacities (e.g. in Torbay) but, generally, the month was characterised by steep and sustained recessions in responsive rivers (northern Scotland excepted). After the exceptional July flooding, flows in the Severn declined to below the early September average. By contrast, flows in spring-fed rivers – benefiting from the lagged impact of the earlier summer rainfall – followed shallow recessions and remained exceptionally high. Most index rivers registered well above average August runoff totals with new monthly maxima common in central southern

England – including the Thames in a series from 1883. Runoff in much of Scotland has been abundant over the last year – for the Naver and Nevis the Sept-Aug runoff is the highest for any 12-month sequence on record – but the most outstanding runoff totals relate to the June-August timeframe. Summer runoff in 2007 exceeded previous maxima for a majority of UK index rivers, in many cases by wide margins. June-August runoff for the Lud was more than twice the previous maximum in a 40-yr series – an appropriate coda for a remarkable summer.

### Groundwater

The development of soil moisture deficits through August served to terminate an extraordinary summer recharge episode. By month end, deficits remained 30-60 mm below average over wide areas (for E&W as a whole, soils were wetter only in 1966 and 2004) but deficits continued to increase in early September. The associated cessation of recharge is clearly evident in the groundwater level hydrographs for a number of responsive aquifers (including the Jurassic and Carboniferous Limestones). Elsewhere, groundwater levels increased in August as water in the unsaturated zone reached the water-tables. In the Chalk of the Yorkshire and Lincolnshire Wolds, new maximum August levels were reported for Aylesby, Wetwang and Dalton Holme, the latter in a series from 1889 (only 1912 shows a comparable response). Levels were also outstanding in the most south-westerly outcrops and at typical winter levels in parts of the Berkshire Downs. The full effect of the pulse of June/July recharge has yet to register on the hydrographs for many slower-responding units of the Chalk (see the hydrograph for Tilshead). However, the lower summer rainfall is also a factor in relation to the less seasonally extreme late-summer groundwater levels across much of the South East. Levels are now rising briskly in the slow-responding Permo-Triassic sandstones of the Midlands – after several years of depressed levels. In some parts of the Chalk, notably in the northern and western outcrops, there has been sufficient recharge to raise groundwater levels to a point where groundwater flooding is a possibility this winter. Whether flooding actually occurs will be influenced not only by rainfall patterns but also by local aquifer properties (there is, for example, little historical evidence of groundwater flooding in the Yorkshire Wolds).

August 2007



Centre for  
Ecology & Hydrology

NATURAL ENVIRONMENT RESEARCH COUNCIL



British  
Geological Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

# Rainfall . . . Rainfall . . .



## Rainfall accumulations and return period estimates

Area	Rainfall	Aug 2007	Jun 07-Aug 07 RP	May 07-Aug 07 RP	Jan 07-Aug 07 RP	Oct 06-Aug 07 RP
<b>England &amp; Wales</b>	<b>mm</b> <b>%</b>	<b>59</b> <b>78</b>	<b>345</b> <b>170</b> >100	<b>456</b> <b>171</b> >100	<b>742</b> <b>134</b> 35-50	<b>1100</b> <b>133</b> 70-100
North West	mm %	82 75	432 155 30-45	521 147 30-40	879 122 5-15	1405 128 30-40
Northumbrian	mm %	52 62	340 161 30-50	412 150 30-50	659 121 5-15	954 120 10-20
Severn Trent	mm %	40 58	352 191 >>100	461 189 >>100	707 145 >100	984 140 >100
Yorkshire	mm %	44 58	372 186 50-100	449 172 >100	694 132 20-35	976 128 20-35
Anglian	mm %	53 96	264 168 50-80	378 183 >>100	545 140 50-80	731 132 30-50
Thames	mm %	51 86	269 164 30-45	390 177 >100	612 139 30-45	894 139 70-100
Southern	mm %	52 90	266 165 30-50	365 169 >100	608 130 10-20	933 130 20-35
Wessex	mm %	52 76	299 167 30-50	424 176 >100	704 135 20-30	1070 137 50-80
South West	mm %	88 101	365 160 30-45	523 174 >100	969 136 30-40	1450 132 30-50
Welsh	mm %	82 77	463 173 >100	592 168 >100	1043 132 20-35	1655 135 70-100
<b>Scotland</b>	<b>mm</b> <b>%</b>	<b>146</b> <b>125</b>	<b>392</b> <b>132</b> 5-15	<b>528</b> <b>137</b> 30-50	<b>1090</b> <b>128</b> 30-50	<b>1789</b> <b>135</b> >>100
Highland	mm %	184 142	403 120 5-10	587 137 20-35	1321 134 70-100	2199 140 >>100
North East	mm %	107 118	364 154 40-60	481 155 50-100	801 127 20-30	1201 128 40-60
Tay	mm %	118 118	421 163 50-80	530 154 50-80	1027 133 30-45	1664 143 >>100
Forth	mm %	120 123	372 151 30-50	464 144 30-45	899 132 30-50	1465 142 >>100
Tweed	mm %	82 92	356 153 30-45	450 147 30-50	1761 123 10-20	1167 128 30-50
Solway	mm %	124 102	435 145 20-30	542 140 20-35	1014 121 5-15	1684 130 50-80
Clyde	mm %	154 108	400 114 2-5	532 119 5-10	1205 120 10-20	2063 132 >100
<b>Northern Ireland</b>	<b>mm</b> <b>%</b>	<b>98</b> <b>103</b>	<b>377</b> <b>157</b> 30-50	<b>451</b> <b>144</b> 20-35	<b>776</b> <b>116</b> 5-10	<b>1170</b> <b>117</b> 5-10

% = percentage of 1961-90 average

RP = Return period

**Important note:** Figures in the above table may be quoted provided that their source is acknowledged. See page 12. Where appropriate, specific reference must be made to the uncertainties associated with the return period estimates. Generally, the return period estimates are based on tables provided by the Met Office\* but those for Northern Ireland are based on the estimates for north-west England. The estimates relate to the specified region and span of months only (RPs may be an order of magnitude less if n-month periods beginning in any month are considered), they reflect rainfall variability over the period 1911-70 only, and assume a stable climate. (For further details see Tabony, R. C., 1977, *The variability of long duration rainfall over Great Britain*, Scientific Paper No. 37). The timespans featured do not purport to represent the critical periods for any particular water resource management zone and, normally, for hydrological or water resources assessments of drought severity, river flows and groundwater levels provide a better guide than return periods based on rainfall totals. \*In some cases ranking positions of accumulated rainfalls are also considered.

All monthly rainfall totals since March 2007 are provisional.

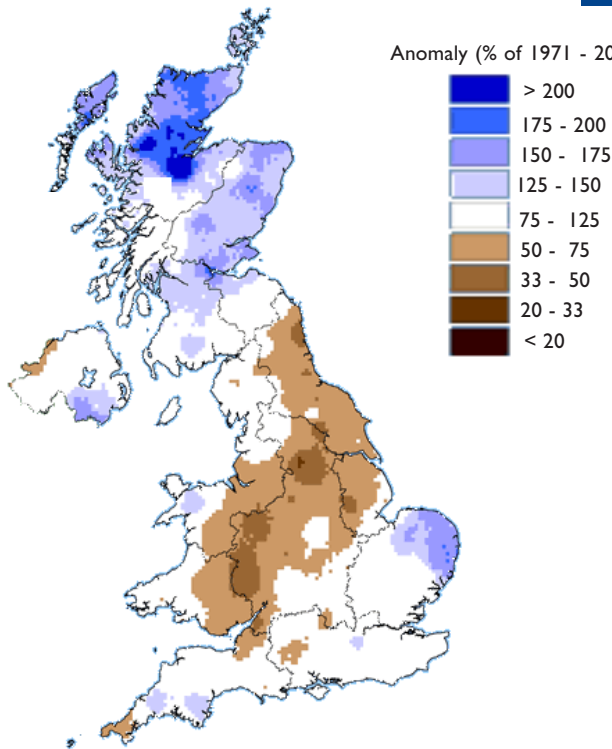
# Rainfall . . . Rainfall . . .



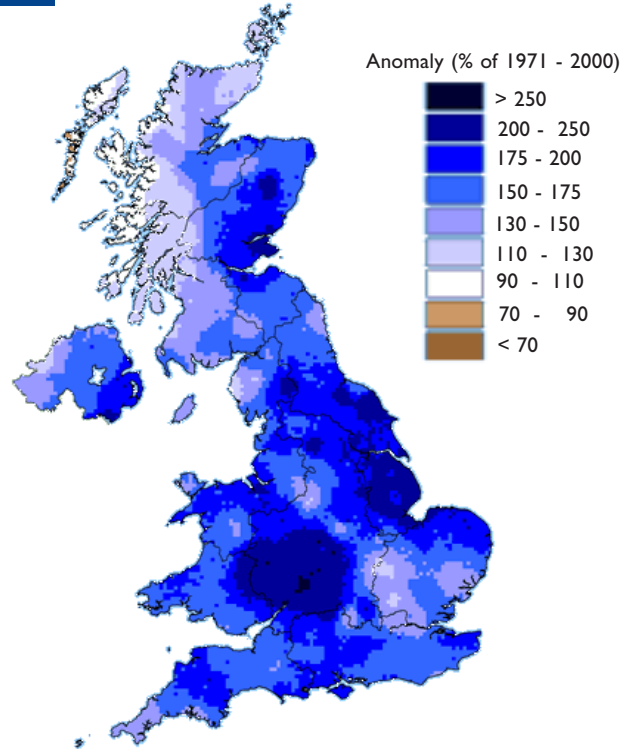
**Rainfall anomaly  
August 2007**



**Rainfall anomaly  
June - August 2007**

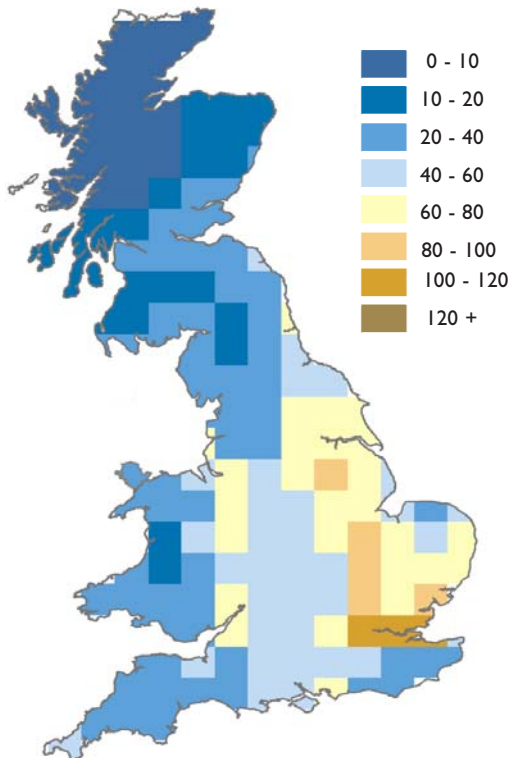


© Crown Copyright



© Crown Copyright

## Soil Moisture Deficit (mm) August 2007



## Met Office Autumn 2007 forecast

This forecast for Autumn 2007 has been derived using global forecasting models and statistical methods. Autumn in this context is defined as the months of September, October and November.

### Forecast for Autumn 2007 issued on 23 August 2007

Our forecasting methods indicate that high pressure systems to the west of the British Isles may be more frequent than is usually the case in autumn. This suggests the following outlook for the UK for Autumn 2007.

- Most likely to be warmer than the 1971-2000 average, though cooler than last autumn
- Average or below-average rainfall is more likely rather than above-average rainfall
- Less frequent periods of very windy weather for autumn as a whole
- Greater risk of fog, compared to normal, during the latter part of autumn

The autumn forecast will next be updated at 10 a.m. on 25 September 2007.

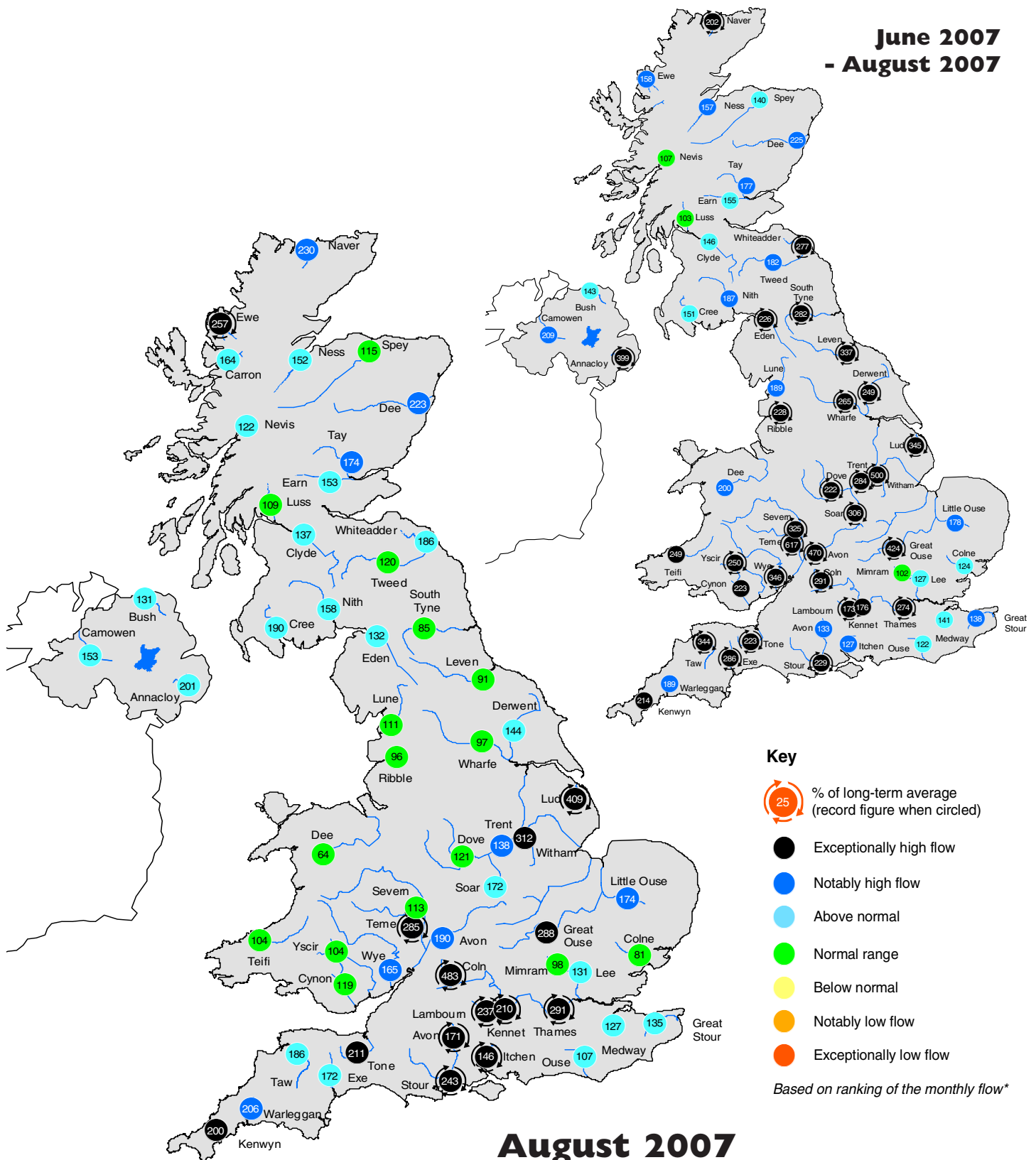
For further details please visit:

<http://www.metoffice.gov.uk/weather/seasonal/autumn2007/index.html>

The rainfall maps are provisional and based on a limited number of raingauges (the August map in particular). The soil moisture deficit map is based on MORECS (see page 12) and assumes a grass cover. End-of-August deficits were 40-80mm below average across large parts of England

# River flow . . . River flow . . .

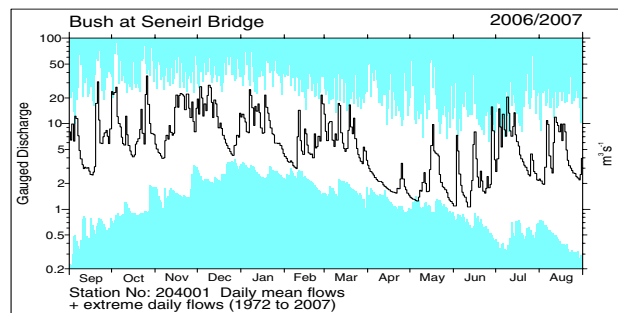
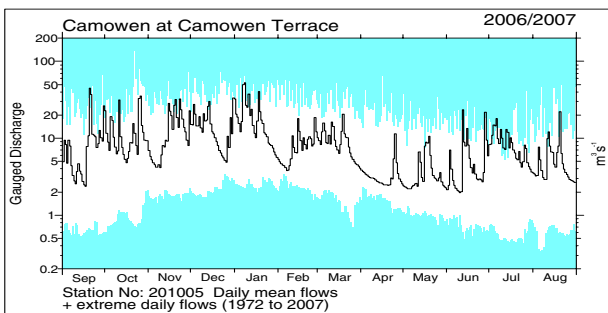
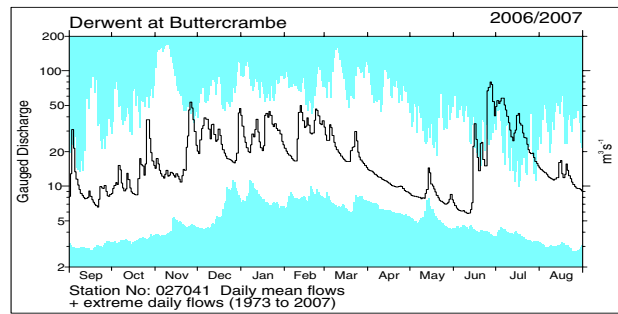
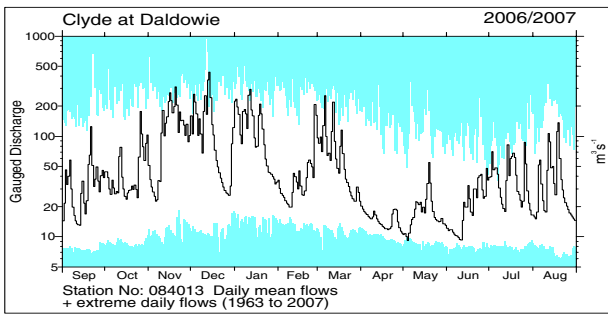
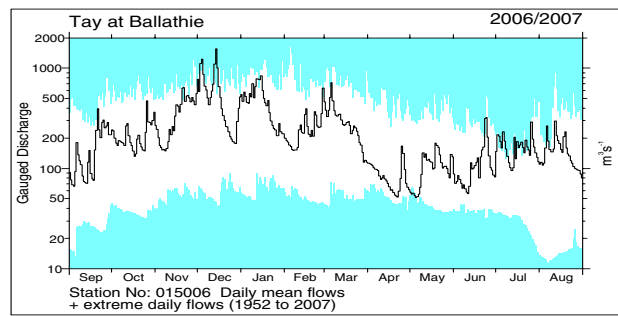
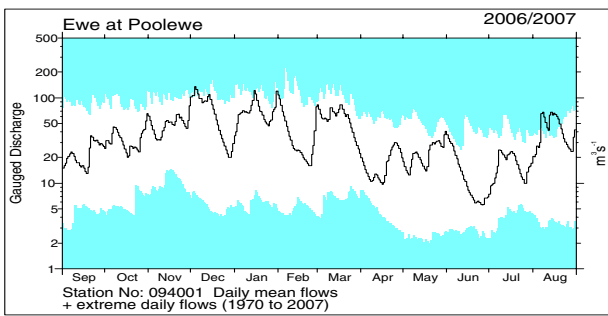
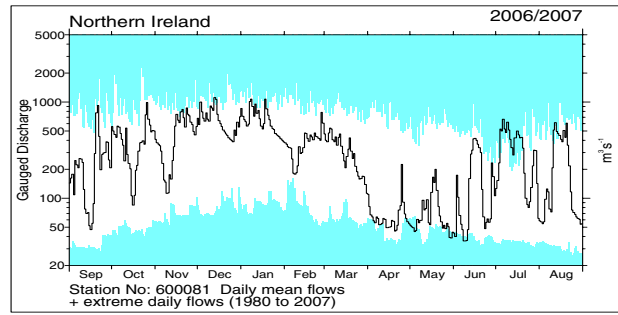
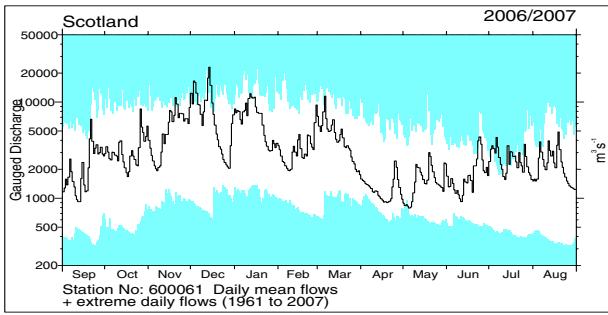
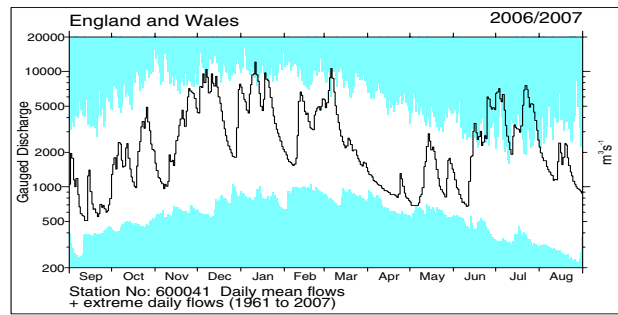
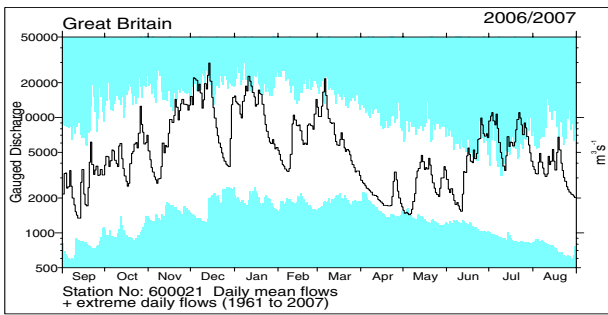
**June 2007  
- August 2007**



## River flows

\*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. Note: the period of record on which these percentages are based varies from station to station. Percentages may be omitted where flows are under review.

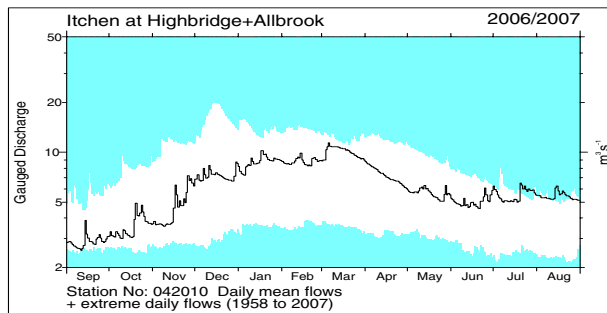
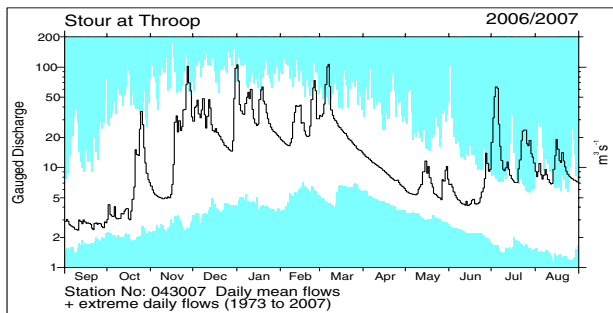
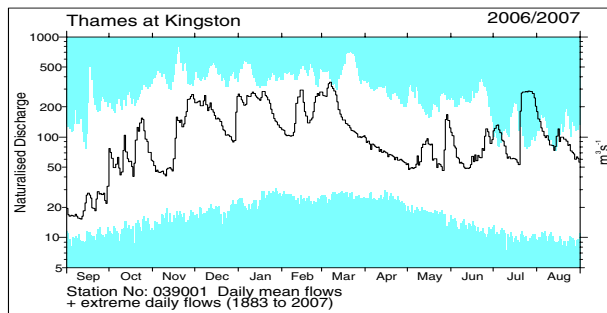
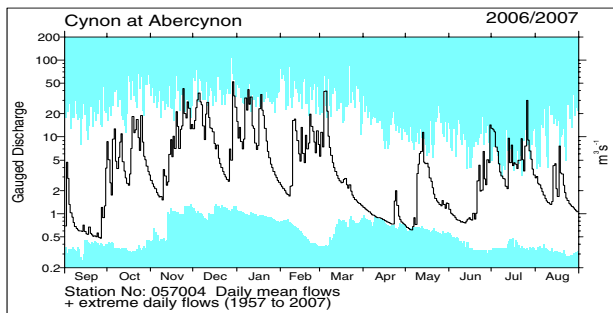
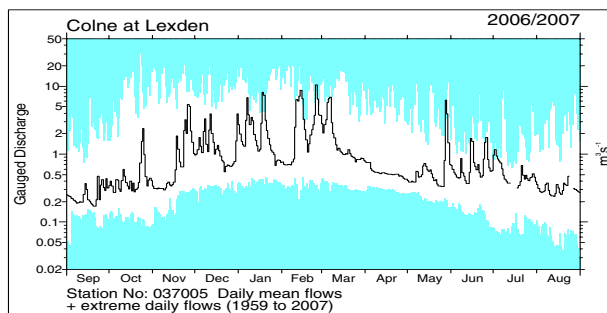
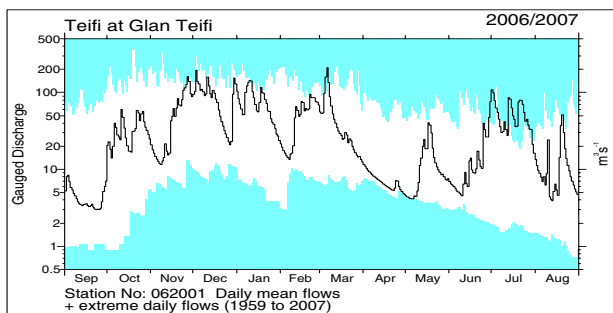
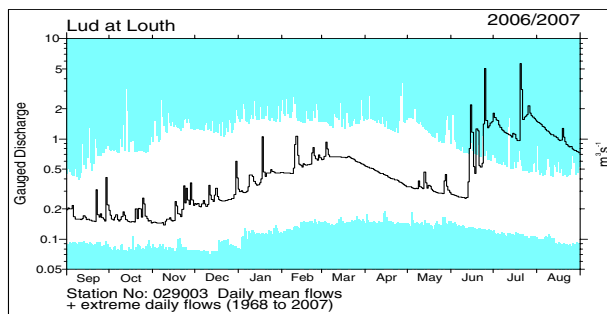
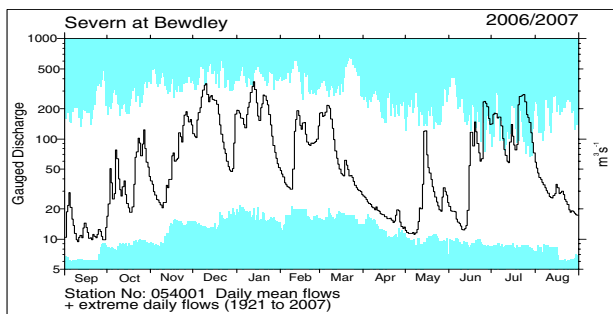
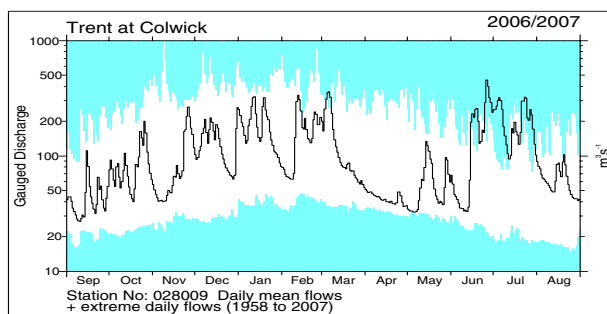
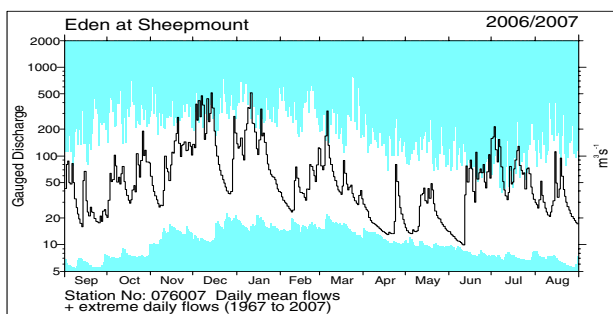
# River flow . . . River flow . . .



## River flow hydrographs

The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to September 2006 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

# River flow . . . River flow . . .

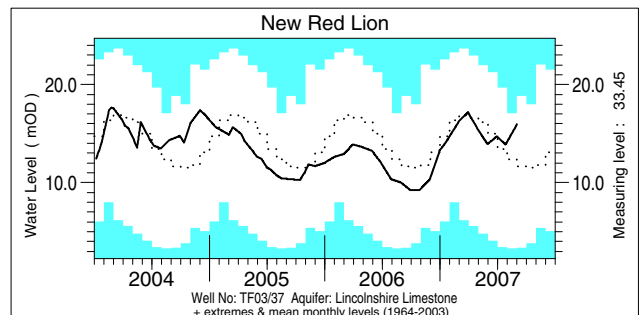
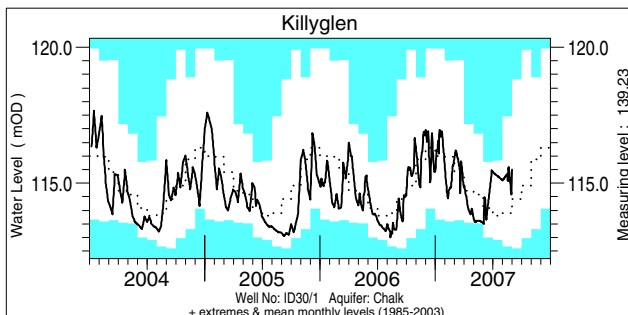
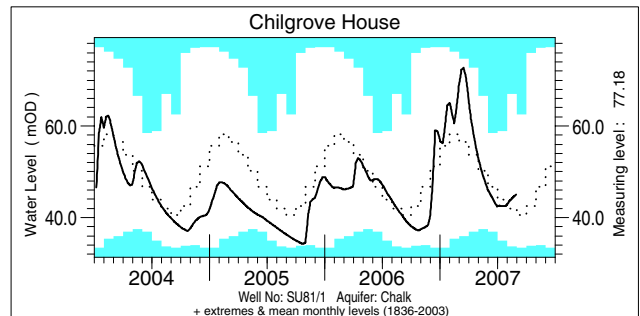
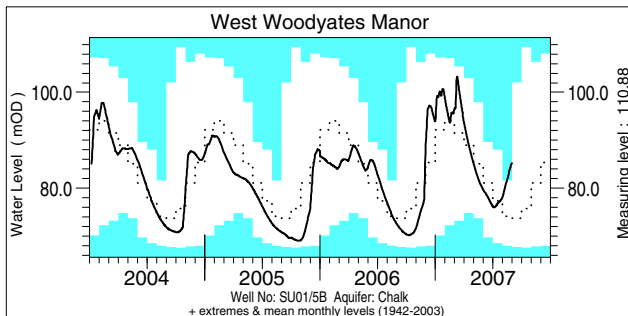
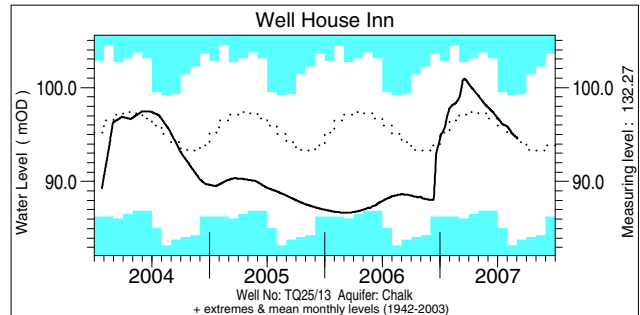
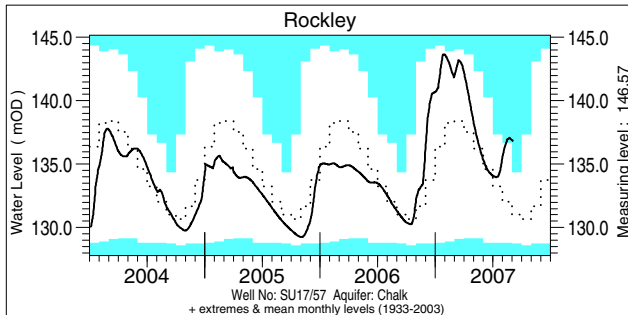
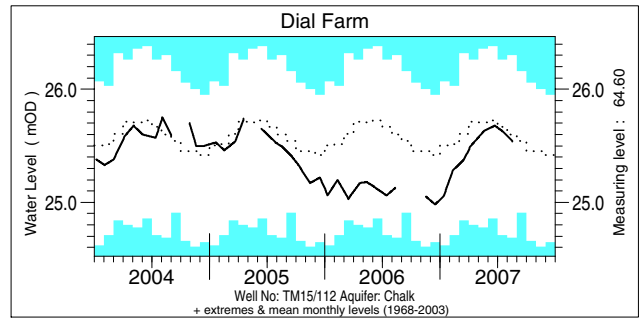
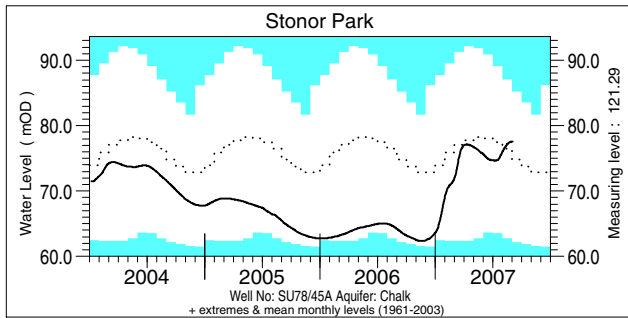
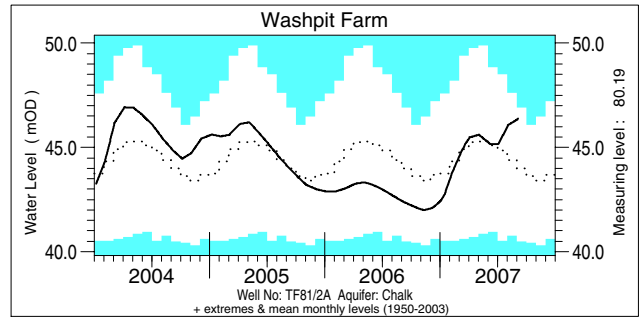
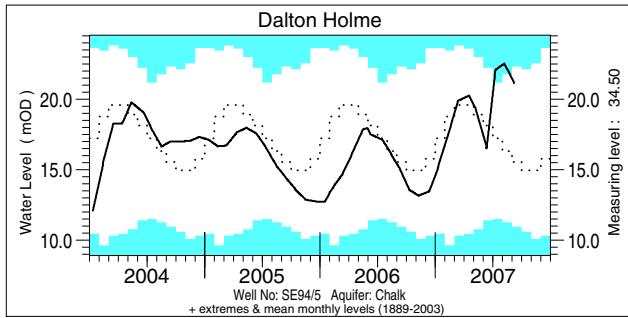


## Notable runoff accumulations (a) June - August 2007, (b) October 2006 - August 2007

River	%lta	Rank	River	%lta	Rank	River	%lta	Rank
a) Whitadder	277	38/38	Severn	325	87/87	b) Tay	145	55/55
Tyne (Bywell)	280	49/49	Avon (Evesham)	470	71/71	Forth	123	26/26
Wharfe	265	52/52	Teme	617	38/38	Tweed (Boleside)	130	46/46
Trent	284	49/49	Wye	346	71/71	Cynon	152	49/49
Witham	500	49/49	Ribble	228	48/48	Nith	137	50/50
Ouse (Bedford)	424	75/75	Lagan	330	35/35	Ewe	131	36/36
Thames	274	125/125	Annacloy	399	28/28	Camowen	134	34/34
Blackwater	197	55/55						
Lymington	345	45/45						
Exe	286	52/52						

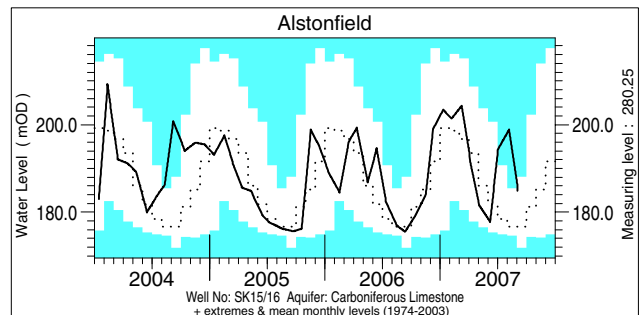
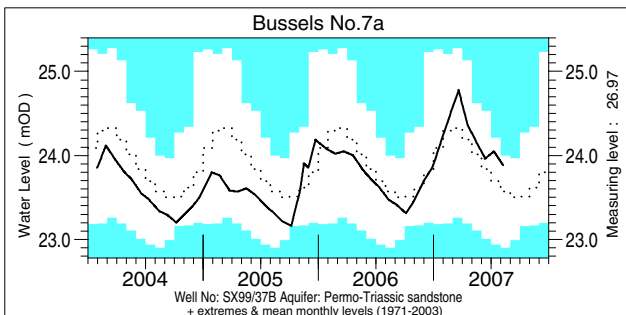
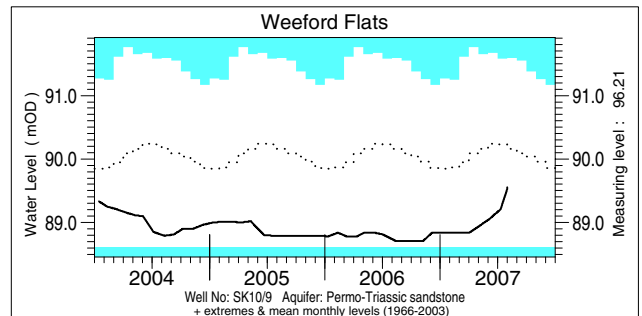
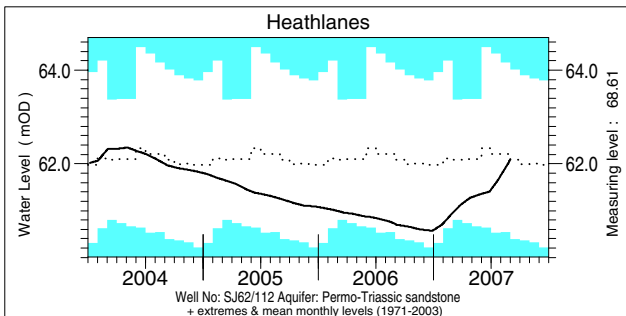
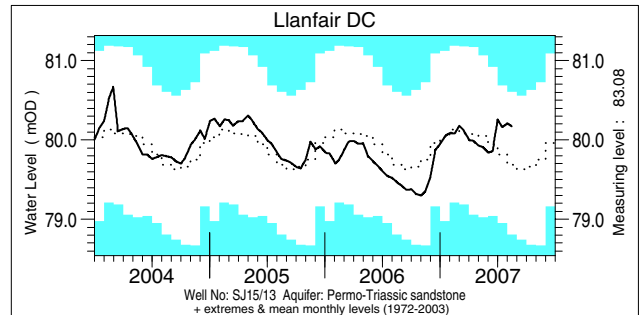
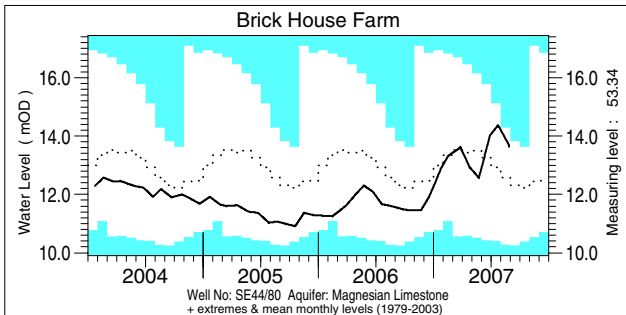
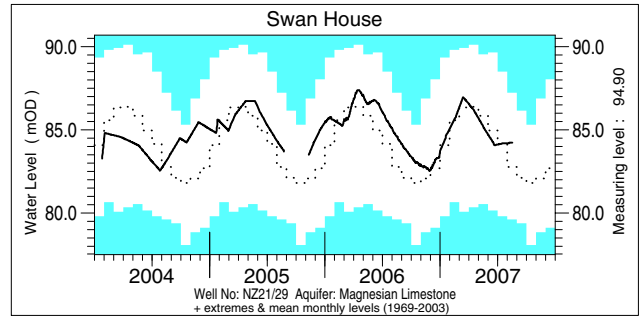
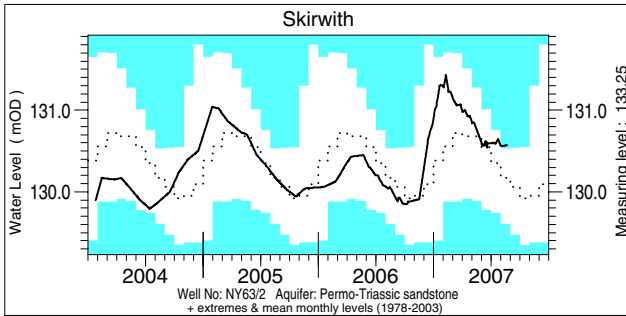
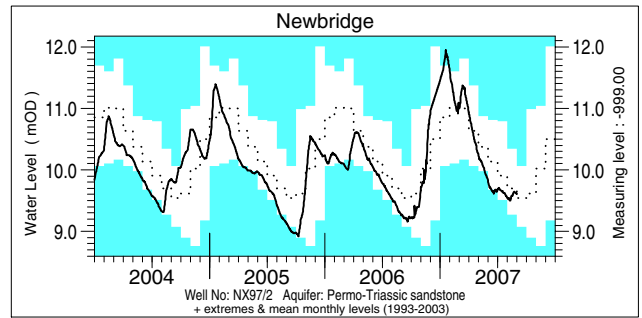
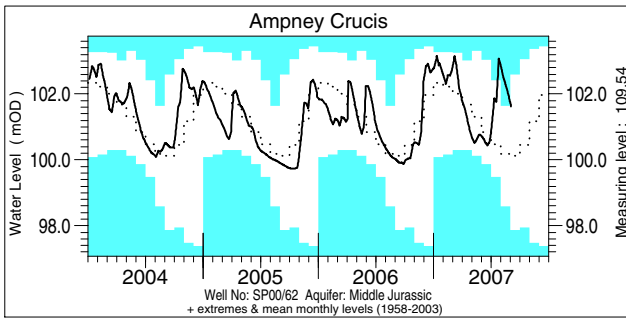
*lta* = long term average  
*Rank 1* = lowest on record

# Groundwater . . . Groundwater



Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined below overlying impermeable strata. The monthly mean and the highest and lowest levels recorded for each month are displayed in a similar style to the river flow hydrographs. Note that most groundwater levels are not measured continuously – the latest recorded levels are listed overleaf.

# Groundwater . . . Groundwater



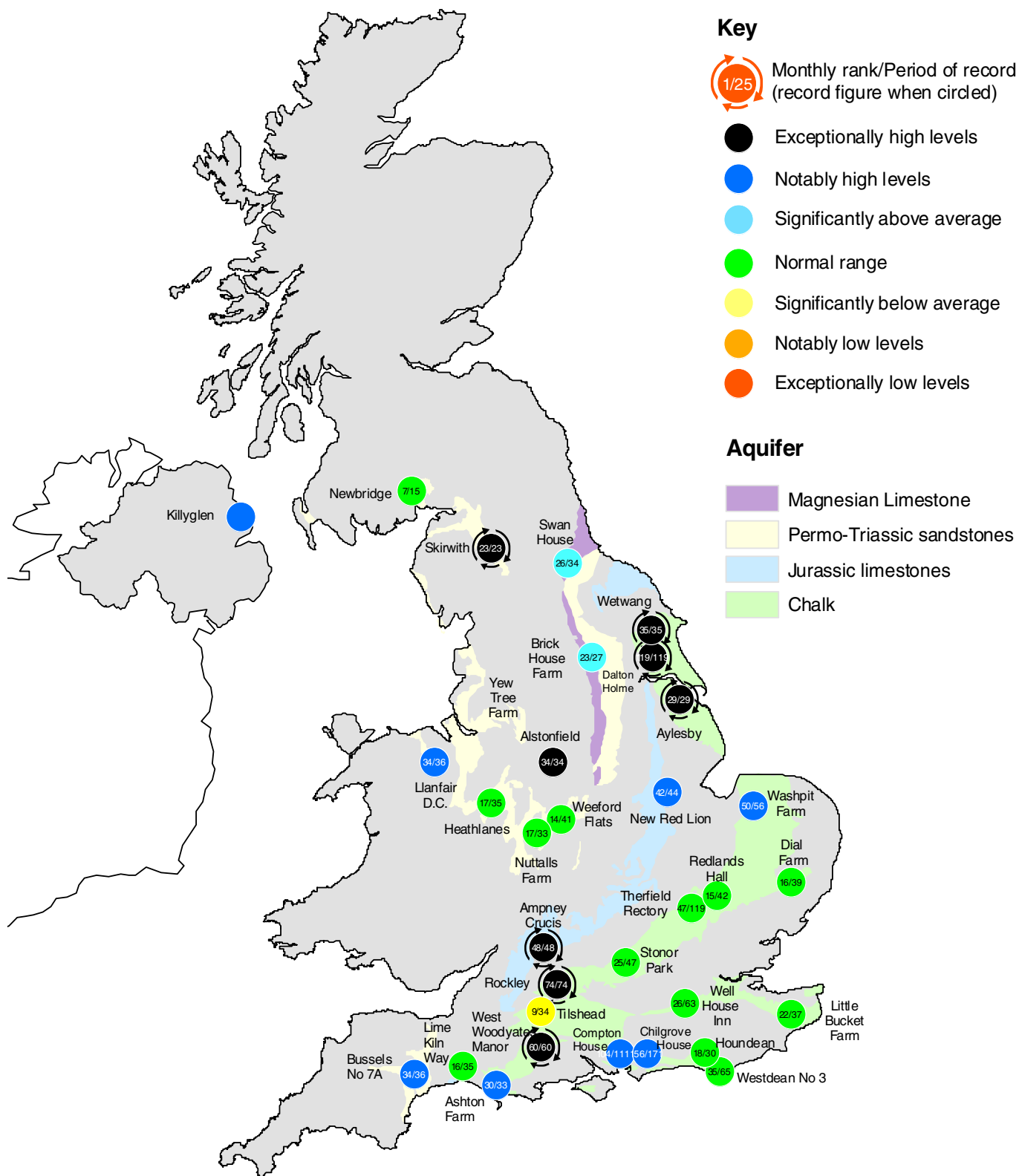
## Groundwater levels August / September 2007

Borehole	Level	Date	Aug. av.	Borehole	Level	Date	Aug. av.	Borehole	Level	Date	Aug. av.
Dalton Holme	21.14	07/09	16.24	Chilgrove House	44.96	28/08	41.70	Brick House Farm	13.64	28/08	12.46
Washpit Farm	46.38	04/09	44.46	Killyglen	115.50	31/08	113.79	Llanfair DC	80.17	15/08	79.63
Stonor Park	77.59	03/09	75.76	New Red Lion	15.99	31/08	12.32	Heathlanes	62.10	31/08	62.10
Dial Farm	25.54	17/08	25.58	Ampney Crucis	101.62	03/09	100.16	Weeford Flats	89.55	01/08	89.82
Rockley	136.84	03/09	132.01	Newbridge	9.60	31/08	9.64	Bussels No.7a	23.88	08/08	23.58
Well House Inn	94.61	03/09	94.89	Skirwith	130.57	20/08	130.15	Alstonfield	184.92	03/09	177.41
West Woodyates	85.20	31/08	73.88	Swan House	84.21	16/08	83.01				

Levels in metres above Ordnance Datum



# Groundwater . . . Groundwater



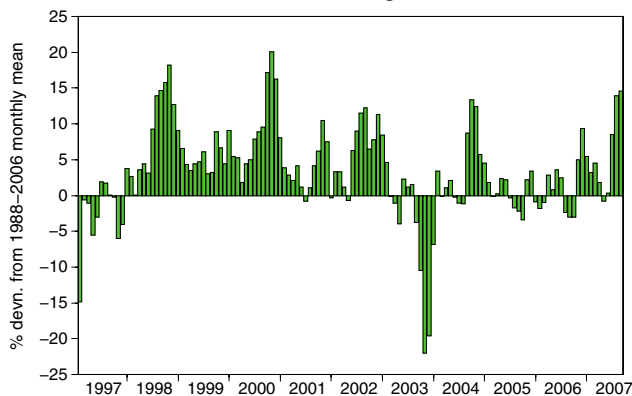
## Groundwater levels - August 2007

The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record. Rankings may be omitted where they are considered misleading.

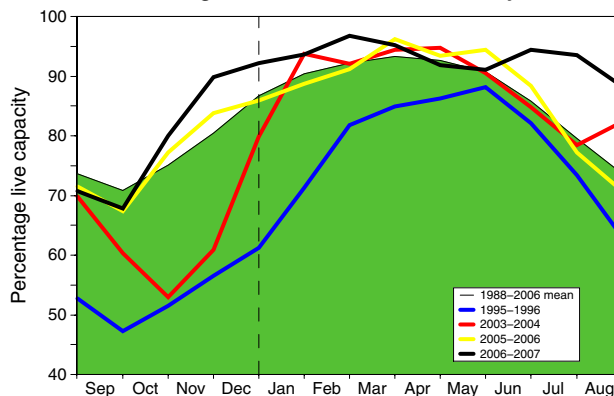
- Notes:
- The outcrop areas are coloured according to British Geological Survey conventions.
  - Yew Tree Farm levels are now received quarterly.

# Reservoirs . . . Reservoirs . . .

## Guide to the variation in overall reservoir stocks for England and Wales



## Comparison between overall reservoir stocks for England and Wales in recent years



These plots are based on the England and Wales figures listed below.

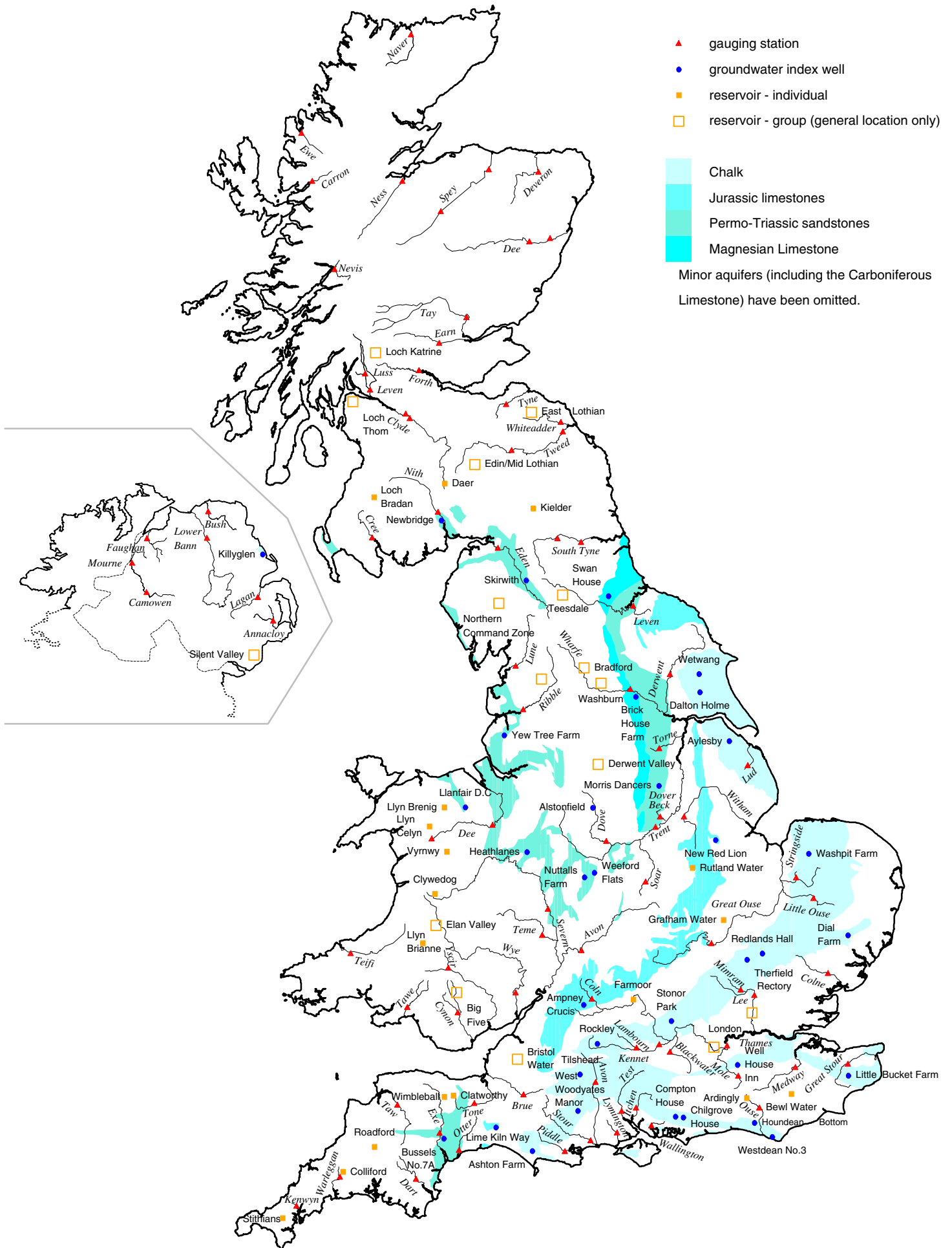
### Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (MI)	2007		Sep	Sep Anom.	Min. Sep	Year* of min.	2006 Sep	Diff 07-06
			Jul	Aug						
North West	N Command Zone	• 124929	82	85	77	23	24	1995	57	23
	Vyrnwy	• 55146	94	96	95	26	36	1995	64	26
Northumbrian	Teesdale	• 87936	98	98	87	24	38	1995	65	24
	Kielder	(199175)	(96)	(94)	(87)	1	(66)	1989	(82)	1
Severn Trent	Clywedog	• 44922	100	100	93	19	38	1989	62	19
	Derwent Valley	• 39525	100	100	90	25	34	1995	66	25
Yorkshire	Washburn	• 22035	99	95	87	21	34	1995	77	21
	Bradford supply	• 41407	96	97	92	29	21	1995	69	29
Anglian	Grafham	(55490)	(97)	(94)	(95)	11	(59)	1997	(83)	11
	Rutland	(116580)	(97)	(94)	(89)	8	(66)	1995	(76)	8
Thames	London	• 202406	89	82	77	-1	62	1995	77	-1
	Farmoor	• 13822	97	94	100	8	64	1995	99	8
Southern	Bewl	• 28170	85	83	79	11	38	1990	68	11
	Ardingly	• 4685	100	100	93	22	47	1996	76	22
Wessex	Clatworthy	• 5364	78	100	100	40	31	1995	62	40
	Bristol WW	(38666)	(98)	(96)	(95)	30	(43)	1990	(76)	30
South West	Colliford	• 28540	79	82	83	14	43	1997	46	14
	Roadford	• 34500	96	99	95	25	40	1995	55	25
	Wimbleball	• 21320	96	100	98	31	40	1995	71	31
	Stithians	• 5205	87	90	83	25	30	1990	47	25
Welsh	Celyn and Brenig	• 131155	99	100	97	18	49	1989	75	18
	Brienne	• 62140	97	100	98	14	55	1995	78	14
	Big Five	• 69762	96	98	90	24	29	1995	52	24
	Elan Valley	• 99106	100	99	93	19	46	1995	65	19
Scotland(E)	Edinburgh/Mid Lothian	• 97639	86	91	88	13	45	1998	77	13
	East Lothian	• 10206	100	100	100	19	63	1989	69	19
Scotland(W)	Loch Katrine	• 111363	72	70	67	-1	50	2000	63	-1
	Daer	• 22412	88	100	96	27	41	1995	63	27
	Loch Thom	• 11840	72	71	72	-6	58	1997	79	-6
Northern	Total*	• 67270	83	86	89	18	40	1995	68	18
Ireland	Silent Valley	• 20634	92	92	97	35	33	2000	66	35

() figures in parentheses relate to gross storage • denotes reservoir groups \*excludes Lough Neagh \*last occurrence

Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2006 period except for West of Scotland and Northern Ireland where data commence in the mid-1990's. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes.

# Location map . . . Location map



# National Hydrological Monitoring Programme

The National Hydrological Monitoring Programme (NHMP) was instigated in 1988 and is undertaken jointly by the Centre for Ecology and Hydrology Wallingford (formerly the Institute of Hydrology - IH) and the British Geological Survey (BGS). Financial support for the production of the monthly Hydrological Summaries is provided by the Department for Environment, Food and Rural Affairs (Defra), the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), the Rivers Agency (RA) in Northern Ireland, and the Office of Water Services (OFWAT).

## Data Sources

River flow and groundwater level data are provided by the Environment Agency, the Environment Agency Wales, the Scottish Environment Protection Agency and, for Northern Ireland, the Rivers Agency and the Department of the Environment (NI). In all cases the data are subject to revision following validation (flood and drought data in particular may be subject to significant revision).

Reservoir level information is provided by the Water Service Companies, the EA, Scottish Water and the Northern Ireland Water Service.

The National River Flow Archive (maintained by CEH Wallingford) and the National Groundwater Level Archive (maintained by BGS) provide the historical perspective within which to examine contemporary hydrological conditions.

## Rainfall

Most rainfall data are provided by the Met Office (see opposite). To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA and SEPA. Following the discontinuation of the Met Office's CARP system in July 1998, the areal rainfall figures have been derived using several procedures, including initial estimates based on MORECS\*. Recent figures have been produced by the Met Office, National Climate Information Centre (NCIC), using a technique similar to CARP. A significant number of additional monthly raingauge totals are provided by the EA and SEPA to help derive the contemporary regional rainfalls. Revised monthly national and regional rainfall totals for the post-1960 period (together with revised 1961-90 averages) were made available by the Met Office in 2004; these have been adopted by the NHMP. As with all regional figures based on limited raingauge networks the monthly tables and accumulations (and the return periods associated with them) should be regarded as a guide only.

The monthly rainfall figures are provided by the Met Office (National Climate Information Centre) and are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

\*MORECS is the generic name for the Met Office services involving the routine calculation of evaporation and soil moisture throughout Great Britain.

The Met Office  
FitzRoy Road  
Exeter  
Devon  
EX1 3PB

Tel.: 0870 900 0100

Fax: 0870 900 5050

E-mail: [enquiries@metoffice.com](mailto:enquiries@metoffice.com)

*The National Hydrological Monitoring Programme depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged.*

## Subscription

Subscription to the Hydrological Summaries costs £48 per year. Orders should be addressed to:

Hydrological Summaries  
National Water Archive  
CEH Wallingford  
Maclean Building  
Crowmarsh Gifford  
Wallingford  
Oxfordshire  
OX10 8BB

Tel.: 01491 838800

Fax: 01491 692424

E-mail: [nwamail@ceh.ac.uk](mailto:nwamail@ceh.ac.uk)

Selected text and maps are available on the WWW at <http://www.nerc-wallingford.ac.uk/ih/nrfa/index.htm>  
Navigate via Water Watch

Some of the features displayed in the maps contained in this report are based on the Ordnance Survey BaseData GB and 1:50,000 digital data (Licence no. GD03012G/01/97) and are included with the permission of Her Majesty's Stationery Office. © Crown Copyright.

Rainfall data supplied by the Met Office are also Crown Copyright. Unauthorised reproduction infringes Crown Copyright and may lead to prosecution.

© This document is copyright and may not be reproduced without the prior permission of the Natural Environment Research Council.

09/07